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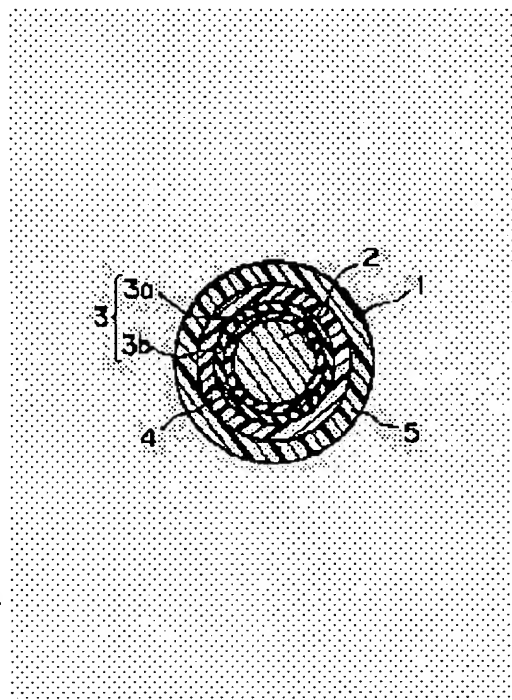
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(54) FIRE RESISTANT ELECTRIC WIRE

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance high temperature insulating characteristics and voltage resistant characteristics, increase flexibility to improve wiring capability, and enhance productivity and economical efficiency by forming a fire resistant layer made of double layers of silicone rubber containing a flame retarder, silicone oil, and powdery mica and an insulating layer on a wire-like conductor.

SOLUTION: A fire resistant layer 3 made of double rubber layers 3a, 3b formed with silicone rubber, and an insulating layer 4 made of synthetic resin such as polyethylene are formed in order on a wire-like conductor 2, and a sheath 5 is formed thereon to obtain a fire resistant electric wire 1. The silicone rubber in the fire resistant layer 3 is formed by mixing 15 pts.wt. or less flame retarder such as zinc borate, 35 pts.wt. or less silicone oil, 25 pts.wt. or less stearic acid, and filling 250 pts.wt. powdery mica having a particle size of 50 μm or more to the 100 pts.wt. silicone rubber. 0.1-3 wt. % vulcanizer is added to the silicone rubber when the rubber layer is formed. The composition of the rubber layers 3a, 3b may be the same or different to exhibit the similar effect.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Even if this invention is put to high temperature, a flame, etc. by the fire etc., it relates to the fireproof electric wire which has the synthetic-resin insulating layer which can bear use of long duration in addition.

[0002]

[Description of the Prior Art] In the location in which many men, such as a theater and a department store, generally gather, when emergencies, such as a fire, occur, it is necessary to guide those who are in the hall to insurance in an emergency exit. In such a case, even if the emergency-exit guidance LGT itself is not destroyed, when the electric wire for power transmission is put to high temperature, a flame, etc., there is a possibility that the situation which an electric wire causes a short circuit for a short time, and power transmission stops may happen. However, since the fixed thing being done for time amount lighting is required, as an electric wire for supplying electric power to an emergency-exit guidance LGT, even when put to high temperature, a flame, etc., an insulation is not destroyed, but an emergency-exit guidance LGT needs for supply of power to be possible.

[0003] There are some which have structure as shown in drawing 2 in the fireproof electric wire used for such the purpose. That is, the fireproof layer 3 is formed in the periphery of a conductor 2, and the fireproof electric wire 1 covers the periphery with the insulating layer 4 which consists of polyethylene, further, it covers a sheath 5 on the periphery, and is formed in it. The fireproof layer 3 of this fireproof electric wire 1 twists the fireproof tape with a thickness of about 0.01-0.2mm which consists of a collection mica sheet which stuck the mica layer on base material film, such as glass tissue and a polyethylene film, and was formed, and is constituted.

[0004] In order to satisfy the insulating property and withstand voltage property in an elevated temperature of 840 degrees C or more which are the fireproof qualification criteria defined by the Fire Defense Agency notification No. 7, this fireproof electric wire The 2-3 above fireproof tapes 2 - 1/4 1/Since it twisted in piles or was twisted and manufactured by *****, The thickness of a fireproof layer was set to 450-600 micrometers, when the sheath was covered on the fireproof layer, the electric wire became thick, lightweight-ization was not completed not only flexibility is bad, but, but there was a difficulty that handling nature is bad.

[0005] then, the dipping method which it is immersed [dipping method] and makes it run a conductor in the coating solution which contains a ceramic particle and silicone system resin in recent years -- using -- a conductor -- the method (for example, JP,63-37922,B) of making the fireproof layer of a ceramic coat form upwards etc. is proposed. However, although general heat-resistant insulation and a withstand voltage property could be given, it could not be satisfied with this approach of the fireproof qualification criteria (the insulation resistance value immediately after heating to 840 degrees C in 30 minutes is 0.4 M omega or more, and withstand voltage is a 1500 V or 1-minute proof pressure) defined by the Fire Defense Agency notification No. 7.

[0006] moreover, as an electric wire which gives flexibility while improving the surface smooth nature of the fireproof electric wire obtained by this dipping method, and suits the fireproof qualification criteria of the above-mentioned Fire Defense Agency notification further Into the mixed liquor which consists of methylphenyl silicone system resin, a diluent, a silane coupling agent, and talc with a particle size of 3 micrometers or less, carry out dipping of the conductor and a fireproof layer is formed. Insulators, such as polyethylene, are covered on this fireproof layer, and what covered and constituted

the sheath further is proposed (JP,7-105733,A).

[0007]

[Problem(s) to be Solved by the Invention] However, such an improved fireproof electric wire the single track suitable for the usual application -- for the applications as which workability is required although there is especially no performance problem when a conductor is used -- a flexible high stranded wire, if it is going to use a conductor the others from which the thickness of a fireproof layer becomes an ununiformity -- since the smooth nature of the front face was also lost, the withstand voltage property of an electric wire fell and there was a problem of it becoming impossible to meet the fireproof qualification criteria.

[0008] what was made in order that this invention might solve the problem of this conventional technique -- it is -- a stranded wire -- even if it uses a conductor -- single track -- the outstanding elevated-temperature insulating property and the outstanding withstand voltage property are held like the time of using a conductor, and it has sufficient flexibility, and aims at offering economically the fireproof electric wire with which workability was improved by the sex from Takao.

[0009]

[Means for Solving the Problem] the purpose of above-mentioned this invention -- a line -- a conductor - the fireproof electric wire characterized by preparing the fireproof layer which consists of a rubber layer of the duplex formed with the silicone rubber filled up with the powder mica upwards including a flame retarder, silicon oil, and stearin acid, and the insulating layer which consists of synthetic resin one by one can attain.

[0010] Furthermore, in the fireproof electric wire of this this invention, the flame retarder blended with the silicone rubber which forms a rubber layer is boric-acid zinc, and that the loadings of whose are below 15 weight sections to the silicone rubber 100 weight section is especially desirable. And the silicon oil similarly blended with silicone rubber can raise productive efficiency, without spoiling fire resistance efficiency by being below 35 weight sections to the silicone rubber 100 weight section.

[0011] And as for the stearin acid blended with the silicone rubber which similarly forms a rubber layer again, it is desirable that they are below 25 weight sections to the silicone rubber 100 weight section, as for the powder mica further blended according to silicone rubber, it is desirable that a path is 50 micrometers or more, and, as for the loadings, it is desirable that they are below the 250 weight sections to the silicone rubber 100 weight section.

[0012]

[Embodiment of the Invention] Although the fireproof electric wire of this invention has the same structure as the conventional fireproof electric wire as essentially shown in drawing 1, the fireproof layer 3 has the dual structure of rubber layer 3a and rubber layer 3b. And although each of rubber layer 3a and rubber layer 3b is formed with the silicone rubber constituent of the specific presentation filled up with the powder mica, even if these are the silicone rubber constituents of the same presentation, you may be the silicone rubber constituent of a different presentation. namely, the fireproof electric wire of this invention -- setting -- a line -- a conductor -- once forming rubber layer 3a upwards, the outstanding fireproof property obtains by forming rubber layer 3b on it further.

[0013] although the silicone rubber of millable types, such as what is preferably called HTV, can be used for the silicone rubber used for forming a rubber layer in the fireproof electric wire of this invention -- a line -- a conductor -- if it can cover with desired thickness upwards, it will not be restricted to this. As this silicone rubber, polymers, such as a dimethyl system, a methylvinyl system, a methylphenyl vinyl system, and a methyl fluoro alkyl system, can be mentioned, for example.

[0014] As a vulcanizing agent blended with the aforementioned silicone rubber, although organic peroxide, such as JIKUMIRU peroxide, dibenzoyl peroxide, G 2 and 4, dichlorobenzoyl peroxide, and perbenzoic-acid-t-butyl, etc. is mentioned, for example, this vulcanizing agent is not necessarily restricted only to organic peroxide. This vulcanizing agent can be suitably chosen according to the class of silicone polymer used, respectively, and desired vulcanization conditions. Moreover, although the loadings can be determined suitably similarly, you may usually be 0.1 - 3% of the weight of the range to a silicone polymer.

[0015] In the rubber layer of the fireproof electric wire of this invention, as a powder mica filled up with and used for silicone rubber, although a thing 50 micrometers or more can use it preferably as a grain size (mean particle diameter), as for a maximum grain size, it is desirable that it is what does not exceed 2.5mm from the point of homogeneity distribution. As for the loadings of this powder mica, it is desirable that they are per [5] silicone polymer 100 weight section - the 250 weight sections. Since a

withstand voltage property is spoiled when there is more amelioration effectiveness of refractoriness when there are few loadings of a powder mica than 5 weight sections clearly than the 250 weight sections, it is not all desirable.

[0016] A flame retarder is blended with the silicone rubber filled up with the above powder micas in order to raise refractoriness further. Although what does not generate a halogenated compound is desirable at the time of combustion, for example, can use the powder of metal hydroxides, such as an aluminum hydroxide and a magnesium hydroxide, etc. for it as this flame retarder, boric-acid compounds, such as boric-acid zinc, etc. are used especially preferably. As for especially the loadings of this flame retarder, it is desirable per silicone polymer 100 weight section that it is 0.1 - 10 weight section extent below 15 weight sections.

[0017] Furthermore, in the silicone rubber used for this invention, in order to avoid the fall of the extrusion nature accompanying the increment in combination, such as a bulking agent, silicon oil is added. As for the loadings of this silicon oil, it is good that they are per [3] silicone polymer 100 weight section - 35 weight sections. Since there is an inclination for the electrical property at the time of an elevated temperature to become unstable when there are few loadings than this, smoothing of a fireproof layer is lost and 35 weight sections are exceeded, neither is desirable.

[0018] Furthermore, in the silicone rubber used for this invention, in order to improve kneading workability, in addition to silicon oil, stearin acid is added. As for the loadings of this stearin acid, it is good that they are per [0.1] silicone polymer 100 weight section - 25 weight sections. If there are few loadings than this, even if it cannot improve kneading workability and will exceed 25 weight sections, kneading workability is not desirable since smoothing of a fireproof layer is lost, in not being improved.

[0019] the line which the above silicone rubber constituents become from single track or a stranded wire -- a conductor -- although it is led to a vulcanizer, it vulcanizes and it becomes a part of rubber layer after turning extrusion covering up, in this invention, on this rubber layer, the laminating of the still more nearly same rubber layer as the above is carried out, and it is formed. Thus, the fireproof layer which consists of a rubber layer of the dual structure which has the outstanding engine performance for the first time is obtained.

[0020] the fireproof layer of the structure in which the rubber layer of such a bilayer carried out the laminating -- a conductor -- if needed, the fireproof wire core obtained by preparing upwards converges, and makes two or more multicore, or covers an insulating layer with single fiber. Although this insulating layer is formed by carrying out extrusion covering of the insulating synthetic-resin constituent using the conventional technique, as this synthetic-resin constituent, olefin system resin constituents, such as polyethylene and polypropylene, are used preferably, for example. In this way, after covering a fireproof wire core with an insulating layer, the fireproof electric wire of this invention is obtained by converging, making two or more into multicore if needed, further, or making two or more [with single fiber] arrange in parallel, and carrying out extrusion covering of the sheath for protection etc. on it.

[0021]

[Example] the methylvinyl silicone system rubber (Toshiba Silicone --) as silicone rubber (SR) as TSE2502U and a vulcanizing agent (CA) -- the Toshiba Silicone make -- as TC-8 and an inorganic bulking agent -- a powder mica (M1) with a grain size of 40 micrometers, a powder mica (M2) with a grain size of 70 micrometers, and a powder mica (M3) with a grain size of 400 micrometers -- as a flame retarder -- as boric-acid zinc (ZB) and silicon oil (SO) -- dimethyl system silicon oil (Toshiba Silicone --) TSF451, viscosity: 1000 cSt, and stearin acid (SA) were blended and kneaded according to combination of Table 1, and the silicone rubber constituent for rubber layers was prepared, respectively. and that whose front face of O and a sheet is ruined in what has the smooth front face of the sheet which evaluated and carried out roll appearance of the kneading workability at this time, and carried out it by the surface state of the sheet obtained with an opening roll was judged to be x.

[0022]

[Table 1]

試験番号	1*	2	3	4*	5*	6*	7	8	9*	10	11*	12*	13	14*	15*	16	17	18*
SR	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
CA	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
M1	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M2	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
M3	-	-	50	50	50	-	10	200	300	50	50	50	50	50	50	50	50	50
ZB	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	10	20	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SO	5	5	5	5	5	5	5	5	5	5	5	-	20	40	5	5	5	5
SA	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	-	2	20	30
耐火層構造																		
ゴム層数	2	2	2	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2
補強層	無	無	無	無	有	無	無	無	無	無	無	無	無	無	無	無	無	無
混練加工性	○	○	○	○	○	○	○	○	×	○	○	○	○	×	×	○	○	×
押出加工性	○	○	○	○	○	○	○	○	×	○	○	×	○	×	○	○	○	×
外観	○	○	○	○	○	○	○	○	×	○	○	○	○	○	○	○	○	○
可撓性	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
常温絶縁性	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
常温耐電圧性	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
高温絶縁性	×	○	○	×	○	×	○	○	×	○	×	○	○	×	○	○	○	○
高温耐電圧性	×	○	○	×	○	×	○	○	×	○	×	○	○	×	○	○	○	○

* : 比較例

[0023] on the other hand -- cross-section 2mm² stranded-wire copper -- to the conductor (1.8mm of diameters), equipment for launching covered each above-mentioned silicone rubber constituent with the extrusion temperature of 60 degrees C, respectively, the 200 more-degree C tubular vulcanizer was passed, and the wire core of 2.4mm of diameters was obtained. And the extrusion nature at this time was evaluated from the operation operability of an extruding press machine, and a homogeneous viewpoint of a product, a setup of the service condition of an extruding press machine was easy, the setting range of O and a service condition was narrow in what can carry out extrusion molding continuously, and continuous running was not easy, or continuous running made the difficult thing x.

[0024] Next, to these silicone rubber coated wire cores, extrusion covering of each silicone rubber constituent was carried out in piles on the same conditions as the above, respectively, and the wire core of 2.8mm of diameters which have the silicone rubber fireproof layer of dual structure was obtained. And extrusion covering of the polyethylene insulating layer was carried out, and it considered as the insulated wire of 4.3mm of diameters at this. After it, extrusion covering of the polyethylene sheath was carried out further, and the fireproof electric wire whose outer diameter is 7.1mm, respectively was obtained.

[0025] For a comparison, only one layer of silicone rubber constituents to moreover, the wire core of 2.4mm of diameters which carried out extrusion covering The wire core of 2.8mm of diameters which twisted and obtained the fireproof mica sheet with a thickness of about 0.01-0.2mm so that it might become 0.2mm in thickness which stuck the powder mica layer and was formed on base materials, such as glass tissue and a synthetic-resin film, The wire core of 2.8mm of diameters which have fireproof rubber covering of a monolayer which carried out extrusion covering thickly and obtained the aforementioned silicone rubber constituent at once was created. And extrusion covering of a polyethylene insulating layer and the polyethylene sheath was carried out one by one like the above using these wire cores, and the fireproof electric wire of the example of a comparison whose outer diameter is 7.1mm, respectively was obtained.

[0026] In this way, about the sample of the wire core which removed the sheath and the insulating layer from each obtained fireproof electric wire, visual inspection and the flexible sex test were performed. Moreover, the trial of the insulating property in an elevated temperature and the withstand voltage property in an elevated temperature was performed in the insulating property in ordinary temperature and the withstand voltage property in ordinary temperature, and the list, these test results were summarized, and the sample started from the fireproof electric wire was collectively shown in Table 1. In addition, these test methods and criteria are as follows.

[0027] (1) The front face of the fireproof layer of an appearance wire core sample was investigated visually, and there was no irregularity, and the uniform thing was made into O and it made the thing without that right x.

(2) The flexible wire core sample was twisted around the mandrel of 10mm of diameters, what a crack does not produce was made into O and the thing without that right was made into x.

[0028] (3) To wide [which were attached at right angles to the truck which can frequent an ordinary temperature insulation heating furnace / 300mm long and 300mm wide], and a pearlite plate with a thickness of 10mm, the fireproof electric-wire sample with a die length of 1.3m was horizontally attached in the location of two places which separated 20cm of the center section using the annealed copper wire of 1.6mm of diameters, respectively, and it fixed. And spacing of about 13mm was kept in the center of the installation location, the both ends of the bundle of two annealed copper wire of 1.6mm of diameters with a die length of 40cm were twisted, and the load which is equivalent to the center section of the annealed copper wire the twice of the weight of a fireproof electric wire with a die length of 1.3m was applied. and a wire core -- the direct current voltage of 500V was impressed between the conductor and the fixed wire, the insulation resistance value in ordinary temperature was measured, what has the resistance of 50 M omega or more was made into O, and the thing without that right was made into x.

[0029] (4) ordinary temperature insulation measurement of the ordinary temperature withstand voltage nature above -- then, a wire core -- the commercial alternating current electrical potential difference of 1500V was impressed between the conductor and the fixed wire, that to which dielectric breakdown does not happen in 1 minute was made into O, and the thing without that right was made into x.

[0030] (5) After performing ordinary temperature withstand voltage nature measurement of the elevated-temperature insulation above, the truck in which the sample of a fireproof electric wire was attached was introduced in the heating furnace, and the temperature up of the heating furnace was carried out to 840 degrees C in 30 minutes. The direct current voltage of 500V was impressed between the conductor and the fixed wire in this condition, the insulation resistance value was measured, what has the resistance of 0.4 M omega or more was made into O, and the thing without that right was made into x.

[0031] (6) The commercial alternating current electrical potential difference of 1500V was impressed between the conductor and the fixed wire, that to which dielectric breakdown does not happen in 1 minute was made into O following elevated-temperature insulation measurement of the elevated-temperature withstand voltage nature above, and the thing without that right was made into x.

[0032] Silicone rubber is received if the test result shown in Table 1 is seen. A flame retarder, The fireproof electric wire which has the fireproof layer of the monolayer structure which covered thickly at once the silicone rubber constituent which blended silicon oil, stearin acid, and a powder mica, and obtained it It turns out that the fireproof electric wire which has the fireproof layer of the two-layer structure which covered in 2 steps thinly and was acquired to sufficient fire resistance efficiency not being shown has the outstanding fire resistance efficiency like the fireproof electric wire which has the fireproof layer which consists of a rubber layer of thin monolayer structure, and a fireproof reinforcement layer which twisted the mica sheet.

[0033] moreover, as a silicone rubber constituent suitable for forming the fireproof layer in the fireproof electric wire of this invention Per silicone rubber 100 weight section and below the boric-acid zinc 15 weight section as a flame retarder It turns out further including below the silicon oil 35 weight section and below the stearin acid 25 weight section that it is desirable from the point of the insulation in an elevated temperature [thing / list / kneading workability, extrusion nature, and] and withstand voltage nature to which grain size comes to blend a powder mica 50 micrometers or more below the 250 weight sections.

[0034]

[Effect of the Invention] The fireproof electric wire of this invention is what has the fireproof layer of the two-layer structure which consists of a silicone rubber constituent filled up with the powder mica, including a flame retarder, silicon oil, and stearin acid. a stranded wire, since it is not necessary to prepare the fireproof reinforcement layer which consists of a mica sheet in combining and having the advanced insulating property which suits the fireproof qualification criteria of the Fire Defense Agency notification No. 7, and the outstanding elevated-temperature withstand voltage property even if it is a core wire using a conductor The productive efficiency of an electric wire is not only improved sharply, but the flexibility of an electric wire is high and it is effective in workability improving sharply.

[Translation done.]